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Evaporative Water Loss in *Opheodrys aestivus* (Colubridae)

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numbers in pools 13 through 18, and, as in the previous winter, had decreased in absolute number.

No other fish species were collected in the system by either dip-netting, seining, or gill-netting. Other vertebrates observed that are potential fish predators were Sonora mud turtles (*Kinosternon sonoriense*), garter snakes (*Thamnophis* sp.), and belted kingfishers (*Megaceryle alcyon*).

Several factors combine to make this population of particular interest. First, only a few disjunct populations of topminnows exist in the United States. Of two recently discovered localities, one was eliminated soon after discovery (McNatt, *Southwestern Nat.*, 24:555, 1979) and the other contains relatively few individuals in a highly fluctuating habitat (Rinne et al., USDA For. Serv. Res. Note, RM-382, 1980). The present locality is therefore a significant addition to known topminnows sites, and may be one of the larger gene pools of *P. o. occidentalis* remaining in the United States. Second, the distribution of both poeciliids throughout the system has remained stable for at least 16 months, contrary to several reported situations where mosquitofish quickly extirpated topminnows after introduction (Miller, *Papers Michigan Acad. Sci., Arts, Lett.*, 46:365, 1961; Minckley and Deacon, *Science*, 159:1424, 1968; Schoenherr, *Ecology*, 58:438, 1977;). Both relative numbers and distribution of these fish changed little since initial observations of the system, and the two species appear to be temporarily coexisting. Longer-term coexistence of these species has been reported at other topminnows localities (Minckley et al., 1977; Meffe et al., in press) and may be partly a function of high habitat complexity, providing refugia and allowing species segregation (Minckley, 1977).

The system reported herein is currently under intensive surveillance by us. With both pure topminnow and topminnow/mosquitofish associations, it is an ideal natural experiment for elucidation of mechanisms involved in species coexistence and/or extirpation.

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RANGE EXTENSION FOR *PROBOSCIDEA SABULOSA* CORRELL (MARTYNIACEAE), A SAND DUNE ENDEMIC.—*Proboscidea sabulosa* (Correll, *Rhodora*, 68:426-427, 1966) heretofore has been known only from sand dunes in Crane, Ward, and Winkler counties, Texas (Correll and Johnston, *Manual of the Vascular Plants of Texas*, Renner, 1970). Surveys of specimens for a generic revision of *Proboscidea* (Bretting, A systematic and ethnobotanical survey of *Proboscidea* and allied genera of the Martyniaceae, Ph.D. dissert., Indiana Univ., Bloomington, 1981) revealed hitherto unrecognized collections of *P. sabulosa* from the extensive Samalayuca dunes in northern Chihuahua (*Henrickson 7497*, 13 Aug. 1972, TEX) and from localized dunes in Socorro Co. (*Bretting 390*, 15 Aug. 1978, IND; *Castetter and Dittmer 6112*, 4 Jul. 1949, UNM; *Manthey 305*, 14 Aug. 1975, UNM) and Lea Co. (*Vaughan 2066*, 21 Oct. 1935, ARIZ), New Mexico. Several of these specimens had been labelled as *P. parviflora* (Woot.) Woot. & Standl. ssp. *parviflora*, a geographically widespread annual in semi-arid and arid northern Mexico and the southwestern United States. Although superficially similar, these taxa do differ by several morphological, anatomical, and chemical characters; *P. sabulosa* is, in fact, the most distinctive annual *Proboscidea*.

No plants of *P. sabulosa* were observed during brief searches at the Chihuahuan and two of the New Mexican localities, but a thriving colony was observed during the summers of 1976-1980 in Socorro Co., NM (source of *Bretting 390*). There it seemed an endemic element rather than an ephemeral "waif." These newly-recognized stations for *P. sabulosa* should be resurveyed in the future—both for this sand dune endemic and for other species (e.g., *Cyperus onerosus* M. C. Johnston., Correll and Johnston, 1970.) now considered strictly endemic to the "sandhills" of West Texas.—P. K. BRETTING, *Dept. of Biology, Indiana Univ., Bloomington, IN 47405*.

EVAPORATIVE WATER LOSS IN *OPHEODRYS AESTIVUS* (COLUBRIDAE).—Many reptiles lose a significant amount of water through cutaneous evaporation, with some values overlapping those found in amphibians (Krakauer, Gans, and Paganelli, *Nature*, 218:659-660, 1968). Krakauer et al. (1968) and Gans, Krakauer, and Paganelli (*Comp. Biochem. Physiol.*, 27:747-761,

TABLE 1.—Statistics of snakes and water loss rates in *Opheodrys aestivus*. Data are $\bar{x} \pm 1$ SE (range).

Category	No. snakes(runs)	\bar{x} SVL(cm)	\bar{x} weight(g)	\bar{x} area(cm ²)	Rate mgg ⁻¹ h ⁻¹	Rate mgcm ⁻² h ⁻¹
<i>O. aestivus</i> adults	9(13)	38.7	12.82	89.12	1.4 ± 0.08 (1.02 - 1.91)	0.18 ± 0.016 (0.130 - 0.276)
<i>O. aestivus</i> hatchlings	10(14)	12.8	1.13	14.95	5.1 ± 0.39 (3.17 - 8.36)	0.39 ± 0.033 (0.211 - 0.627)

1968) observed that water loss could be correlated with habitat preferences: fossorial and terrestrial forms from xeric habitats lose less water than those from mesic environments. To our knowledge, there has not been a study of water loss in arboreal snakes. Arboreal habitats may be more variable in terms of temperature and humidity than terrestrial habitats (Hardy, Southwestern Nat., 23:683-685, 1978); therefore it may be important for arboreal snakes to select optimal microhabitats and/or possess physiological adaptations to decrease water loss compared to forms from less desiccating habitats. We here describe water loss in *Opheodrys aestivus* (rough green snake), an arboreal snake which normally is found in vegetation from 1 to 14 m above the ground, in populations along the shoreline of Bald Knob Lake, White Co., Arkansas.

Snakes, ranging in size from newly matured to large adults (33 - 49 cm snout-vent length), were collected from mid-May until late June 1979. Hatchlings (10 - 14 cm SVL) were obtained from eggs laid by captive females. Caged, fasting snakes were kept in the lab with water available at least 24 h before being tested. Water loss was determined with an apparatus similar to that used by Gans et al. (1968). Air flowed at rates of 300 to 500 ml/min from an adjustable air supply through three drierite chambers which collected moisture. This system produced air of <10% humidity and a temperature of 27.5 ± 1°C. Changes in flow rates had no significant effect on rates of water loss (Gans et al., 1968). The air then flowed through a desiccation chamber which contained the snake, through two drierite chambers, which collected the moisture released by the snake, and finally through an air flow gauge. The desiccation chamber was covered during each run in order to minimize stimulation of the snake and thereby minimize water loss variation due to variations in activity (Gans et al., 1968). Before each test, the snake was weighed to the nearest 0.1 mg and the vent was taped to prevent excretion. Snout-vent length and sex were recorded. After each run of 4 h, snakes were again weighed to the nearest 0.1 mg. The weight difference was assumed to be due to water loss. Although this method measures total water loss, in the other

TABLE 2.—Rate of water loss among snakes of various taxa taken from the literature. The equation $R = 5.14 W^{0.51}$ is for *Opheodrys aestivus* (present study).

Taxon	Body wt. (g)	Water loss (mg/g/hr)		Habitat	Authority
		As measured by investigator	As predicted by $R = 5.14 W^{0.51}$		
Typhlopidae					
<i>Typhlops</i> (4 spp.)	0.42-3.8	25-77	2.60-8.00	fossorial-mesic	1
Aniliidae					
<i>Cylindrophis rufus</i>	6.5	13.8	1.98	fossorial-mesic	1
Boidae					
<i>Eryx conicus</i>	41.2	0.4	0.77	fossorial-xeric	1
Colubridae					
<i>Dasyplectis atra</i>	19.8	2.3	1.12	terrestrial-woodland	1
<i>Lampropeltis triangulum</i>	69.2	1.9	0.59	terrestrial	1
<i>Natrix sipedon</i>	74.0	1.6	0.57	aquatic	1
<i>Pituophis melanoleucus</i>	46.6	0.8	0.72	semi-arid terrestrial	1
<i>Carphophis vermis</i>	5.7	6.2	2.11	fossorial-mesic	2
<i>Diadophis punctatus</i>	3.5	4.2	2.71	terrestrial-fossorial	2
<i>Tantilla gracilis</i>	1.8	7.3	3.81	fossorial-mesic	2
<i>Storeria</i> spp.	4.8	2.1	2.31	terrestrial	2
<i>Virginia valeriae</i>	5.4	1.4	2.17	terrestrial-fossorial	2

¹Gans, et al. (1968); 2, Elick, et al. (1972).

snake species studied, cutaneous water loss accounts for 50 to 80% of the total and accounts for most of the interspecific differences (Prange and Schmidt-Nielsen, *Comp. Biochem. Physiol.*, 28:973-975, 1969). Surface area was determined by killing the snake, skinning it, and making a tracing of the skin on graph paper (Elick and Sealander, *Amer. Midland Nat.*, 88:429-439, 1972). The tracing was cut out, weighed, and compared to the weight of a 1 cm² piece of paper.

Adult *O. aestivus* lost water (Table 1) at a rate below that of many terrestrial and fossorial forms (Gans et al., 1968; Elick and Sealander, 1972). In addition, adult *O. aestivus* lost water at a lower rate than hatchlings (Table 1, $P < 0.001$, *t*-test). The relationship between body weight and water loss is described by the regression equation, $R \text{ (rate)} = 5.14 W \text{ (body weight)}^{-0.51}$ ($r = 0.64$, $P < 0.01$). The same general trends are found when water loss is regressed against surface area ($R = 1.18 \text{ (surface area)}^{-0.43}$, $r = 0.50$, $P < 0.01$). As water loss is a surface area phenomenon, this relationship may be closer to the parametric relationship. Most other published values for water loss are expressed by weight, so we used $\text{mg g}^{-1} \text{ h}^{-1}$ to compare our data with these values.

To our knowledge, only one other regression equation for water loss has been determined for a snake ($R = 5.05 W^{-0.40}$; *Elaphe climacophora*, Gans et al., 1968). The intercept of the equation for *O. aestivus* is similar to that for *E. climacophora*; however, *O. aestivus* has a significantly ($P < 0.05$) steeper negative slope which predicts less water loss at the same body weight. We compared published values of water loss in snakes to those predicted by our equation at the body weights given by Gans et al. (1968) and Elick and Sealander (1972) (Table 2). Snakes from mesic fossorial or mesic terrestrial habitats lost more water than our equation predicted. Snakes from xeric habitats lost less than predicted. The general trend was for *O. aestivus* to lose less water than other snakes tested except the vipers, which lose little water regardless of habitat (Chew and Dammann, *Science*, 133:384-385, 1961; Dmi'el, *Amer. J. Physiol.*, 223:510-516, 1972) and those from extremely xeric conditions. Our data suggest that one adaptation to arboreality in *O. aestivus* may be reduction in cutaneous water loss as was suggested for arboreal frogs by Bentley and Yorio (*Comp. Biochem. Physiol.*, 62A:1005-1009, 1979).

We thank M. Groves and L. Riggins for typing the manuscript.—LAURA B. DOVE, DENNIS A. BAEYENS, AND MICHAEL V. PLUMMER, *Dept. of Biology, Harding Univ., Searcy, AR 72143* (LBD AND MVP) and *Dept. of Biology, Univ. of Arkansas at Little Rock, Little Rock, AR 72204* (DAB) (Present address LBD: *Dept. of Biology, Univ. of Houston, Houston, TX 77004*).

AMBYSTOMA MACULATUM (AMBYSTOMATIDAE) IN THE DIET OF *HETERODON PLATYRHINOS* (COLUBRIDAE) FROM NORTHERN ARKANSAS.—Platt (*Univ. Kansas Publ., Mus. Nat. Hist.*, 18:253-420, 1969) reviewed the food habits of the eastern hognose snake, *Heterodon platyrhinos*, reporting that the tiger salamander (*Ambystoma tigrinum*) was a rare food item. Anurans generally are recognized as the primary prey items throughout its range, but several other amphibians, including salamanders of the family Ambystomatidae (*A. tigrinum* and *A. opacum*), have been reported as prey. The following account represents the first published report on the spotted salamander, *A. maculatum*, as a food item of *H. platyrhinos*.

During a field trip in the Ozark Highlands, I collected a female *H. platyrhinos* (ca. 665 mm in total length) beneath a piece of tin roof adjacent to a farm pond, 1.8 km N Yellville, Marion Co., Arkansas. During transfer between sacks, she began to regurgitate two adult *A. maculatum*. Both were egested head first and showed signs of partial digestion of the lower extremities. This suggests that these prey were consumed tail first.

Specimens are currently deposited in the Georgia Southwestern College herpetological collection (GSC 2105-06).

I thank Dr. James D. Yarbrough of Mississippi State Univ. for field funds.—STANLEY E. TRAUTH, *Dept. of Biological Sciences, Mississippi State Univ., Mississippi State, MS 39762* (Present address: *Dept. of Biology, Georgia Southwestern College, Americus, GA 31709*).

NOTES ON LONGEVITY OF *GOPHERUS BERLANDIERI* (TESTUDINIDAE).—Tortoises are often cited as examples of long-lived species, but in fact, little is known about their longevity. There are four living species of tortoises in North America; i.e., *Gopherus agassizii*, *G. berlandieri*, *G. flavomarginatus*, and *G. polyphemus*. Nichols (*Herpetologica*, 13:141-144, 1957) reported that a captive male *G. agassizii* was alive at 32 or 33 years of age. Auffenberg and Iverson (pp. 541-569, in *Turtles, Perspectives and Research* [Harless and Morlock, eds.], John Wiley & Sons, New York, 1979) noted that the longevity of *G. polyphemus* is >25 years. They also stated that growth rings usually are useless in determining the age of old individuals because the scutes are